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Current practice of the adult patient population in a new bronchology and interventional pulmonology unit: A three-year experience

Current interventional pulmonology practice

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Abstract

Aim: Interventional pulmonology involves both diagnostic and therapeutic procedures that primarily use a rigid bronchoscope. There is still a lack of consensus on case management, the choice of treatment method and treatment procedures. It is important to share the procedures adopted and the individual cases in interventional pulmonology, as this is still a developing field. Accordingly, we share here our first experiences in our newly founded interventional pulmonology unit.

Material and Methods: This study is a retrospective cohort study based on a review of interventional procedures performed for diagnostic and therapeutic purposes between January 1, 2016, and June 30, 2018.

Results: One hundred twenty-four interventional procedures were performed on 107 cases in our interventional pulmonology unit. The mean age of the patients was 54.3±17.5 years, and 71% were male, 29% were female. The reasons for the procedures were diagnostic in 16.9%, therapeutic in 35.4%, and both diagnostic and therapeutic in 47.7%. Of the procedures performed, 42.0% were for tumor excision due to malignant obstruction, 15.3% for diagnostic biopsy, 12.9% for total lung lavage, 16.1% to determine the etiology of hemoptysis, 9.7% for tracheal dilatation and stent applications, and 4% foreign body removal.

Discussion: We believe that sharing interventional bronchology procedures will help more patients benefit from such treatments and contribute to the standardization of practices.

Keywords

Bronchoscopy, Airway Management, Argon Plasma Coagulation, Cryotherapy

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Introduction

Interventional pulmonology involves both diagnostic and therapeutic procedures that primarily use a rigid bronchoscope under general anesthesia in the operating room. There are many indications for rigid bronchoscopy, including hemorrhage, foreign body extraction, the need for a deeper biopsy specimen when a fiberoptic specimen is inadequate, the dilation of tracheal or bronchial strictures, the relief of airway obstructions, the insertion of stents [1]. The methods used during rigid bronchoscopy procedures include mechanical methods such as mechanical tumor ablation, rigid dilatation, and stents; heat-based methods such as electrocautery, argon plasma coagulation and laser; and cold-based methods such as cryotherapy.

Patients with newly diagnosed lung cancer have been reported to develop complications related to partial or complete airway obstruction during follow-up at a rate of 20–30% [2]. In tumor cases with airway obstruction, advanced endoscopic therapies enable palliation by maintaining airway patency, while also allowing for adjuvant therapy in cases with morbidities that preclude surgical therapy or chemoradiotherapy.

Endobronchial therapies have gained increased importance in the management of central airway pathologies [3]. The method to be applied is determined considering the patient's overall status, lesion form, urgency of the clinical condition and complaints, disease stage, available resources, and the experience of the clinician [4].

Patients with airway obstruction secondary to benign tumors are candidates for surgery [5,6]. Surgeries on large airways are challenging, and bronchoscopic therapy plays a key role in removing the obstruction and improving ventilation [7]. The bronchoscopic techniques most commonly used for the treatment of benign tracheobronchial tumors include electrocautery, argon-plasma coagulation and neodymium-doped yttrium aluminum garnet (Nd: YAG) laser and cryotherapy [8].

Despite the available information, there is still a lack of consensus on case management, the choice of treatment method and treatment procedures in terms of interventional pulmonology. It is important to share the procedures adopted and the individual cases in interventional pulmonology, as it is still a developing field. Accordingly, we share here our first experiences in our newly founded interventional pulmonology unit.

Material and Methods

The study involved a retrospective analysis of the files of cases that underwent diagnostic and therapeutic interventional procedures between January 1, 2016, and June 30, 2018, in the newly founded Department of Interventional Pulmonology at our hospital. The data recorded about each case included demographic, clinical, and radiological details, indications, the interventional procedures applied, complications, and diagnoses.

Argon plasma coagulation (40 Watt, blended mode-continuous flow) was performed using a device manufactured by ERBE Elektromedizine GBMH (Tubingen, Germany). Standardized protocols for appropriate power selections were used in accordance with the manufacturer's recommendations. Cryotherapy was performed using the ERBOKRYO system (Elektromedizine GBMH,Tübingen,Germany). Electrocautery applications were performed using the electrosurgical unit, ERBE Medizintechnik, GmbH, Tübingen, Germany). All the patients were intubated by a rigid bronchoscope (Efer Endoscopy, LaCiotat, France) under general anesthesia using Standard techniques, and mechanical debridement was performed when necessary.

All procedures were performed in the operating room. Prior to the procedure, informed consent forms were obtained from all cases and an anesthesia assessment was made. Cases for which no consent forms could be obtained, or those who declined anesthesia, were excluded from the study. The treatment to be applied was determined by two interventional pulmonologists based on the type and localization of the lesions and the clinical condition of each case. Ethics committee approval was received for our study (Süreyyapasa Chest Diseases and Thoracic Surgery Training and Research Hospital Ethics Committee; 116.2017.R-279/16.03.2023). The study was conducted following the principles and guidelines of the Declaration of Helsinki for medical research involving human subjects.

Statistical Analysis

The Statistical Package for the Social Science for Windows 15.0 package program (SPSS Inc., Chicago, IL, USA) was used in our study. The median with interquartile range was employed for nonparametric continuous variables, and mean±standard deviation was used for parametric continuous variables. $P<0.05$ values were considered statistically significant.

Ethical Approval

Ethics Committee approval for the study was obtained.

Results

Between January 1, 2016, and June 30, 2018, 124 interventional procedures were performed on 107 cases in our interventional pulmonology unit. The mean age of the patients was 54.3±17.5 years, and 71% were male. The reason for the procedures was diagnostic in 16.9%, therapeutic in 35.4%, and both diagnostic and therapeutic in 47.7%.

The distribution of the applied processes is shown in Table1. Twenty-five of the tumors were located in the right bronchial system, 19 in the left bronchial system and 8 in the trachea.

Of the malignant tumor cases, 33 (49.2%) were squamous cell carcinoma, 14 (20.9%) were adenocarcinoma, 11(16.4%) were small-cell carcinoma, five (7.5%) were carcinoid tumor, two (3.0%) were verrucous carcinoma and one (1.5%) was a mixed tumor with a neuroendocrine tumor component. Obstruction-related post-obstructive pneumonia or dyspnea was identified in three and hemoptysis in two of the five carcinoid cases.

The benign lesions undergoing procedures in the interventional pulmonology unit were diagnosed with anthracosis, glandular papilloma, mucosal polyp, aortobronchial fistula, endobronchial tuberculosis and hamartoma. The method applied for the endobronchial therapy of malignant and benign lesions was cryotherapy in 43%, tumor debulking in 51%, APC in 38%, electrocautery in 24% and tracheal dilatation in 11%. These endobronchial therapies were used alone or in combination, depending on the patient and lesion.

Table 1. Distribution of applied processes.

Procedures	Number of procedures (n:124)	%
Tumor excision	52	42
Determining the etiology of hemoptysis	20	16.1
Biopsy	19	15.3
Total lung lavage	16	12.9
Tracheal dilation and stent applications	12	9.7
Foreign body	5	4.0

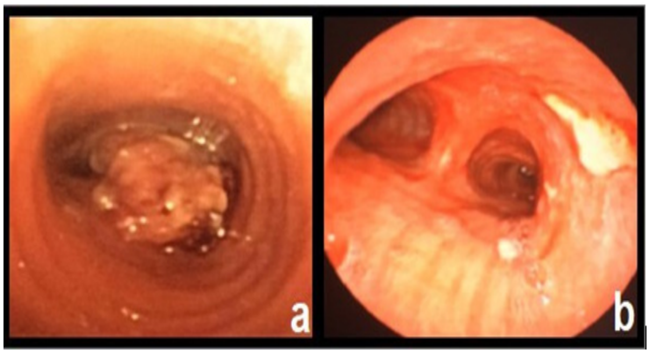

Figure 1. a: Bronchoscopic view of the patient with tracheal adenocarcinoma before interventional therapy.
b: Bronchoscopic view of the patient with tracheal adenocarcinoma after interventional therapy.

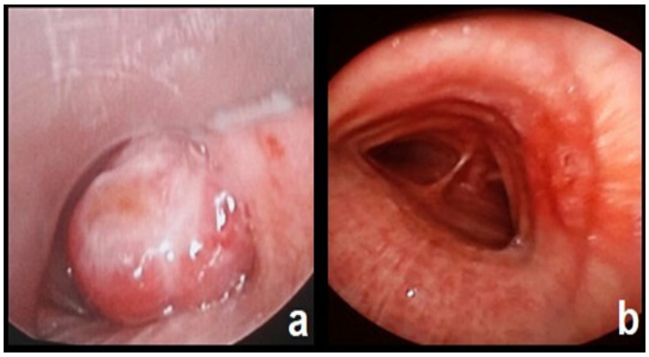

Figure 2. a: Tracheal hamartoma before therapeutic procedures.
b: Tracheal hamartoma after therapeutic procedures.

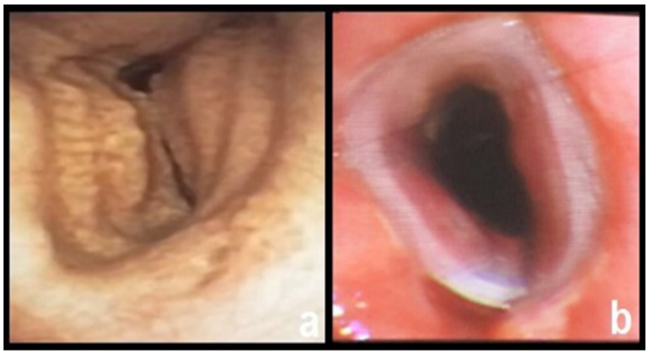

Figure 3. a: Tracheal stenosis due to tracheobronchopathia osteochondroplastica before stent.
b: Tracheal stenosis due to tracheobronchopathia osteochondroplastica after stent.

A foreign body was extracted using a rigid bronchoscope in five cases other than the malignant and benign cases. Rigid bronchoscopy was performed to detect the focus of bleeding due to massive and sub-massive hemoptysis in 20 of the cases. Additionally, three cases diagnosed with Pulmonary Alveolar Proteinosis (PAP) underwent a total of 16 whole lung lavage procedures.

Among the 12 cases in which tracheal stenosis was detected, 10 were post-intubation stenosis, one was caused by a post-intubation tracheal fungal infection, and one was caused by tracheobronchopathia osteochondroplastica. Patients with post-intubation stenosis were dilated with a rigid bronchoscope, and for cases requiring operations, consultation with the Thoracic Surgery Department was carried out. A tracheal stent was placed in three of these cases: with a stenotic silicon stent fitted in two cases and straight silicone in one case.

Considering the complications, no procedure-related deaths occurred among our cases, although two cases developed massive hemoptysis during the procedure and were placed in intensive care. One case was intubated with a double-lumen endotracheal tube due to massive hemoptysis and placed in intensive care after becoming stable. For the other case, a tracheostomy was required because ventilation could not be provided through intubation during the procedure. The patients were followed up in intensive care, and then discharged.

Discussion

In this study, which was conducted to share the three years of experience gained in our new Interventional Pulmonology unit, we convey the characteristics and diagnoses of the cases to date, along with the endobronchial therapy methods used.

The treatment modalities recommended for the reduction of cough, hemoptysis, and dyspnea in patients with symptomatic airway stenosis in lung cancer are mechanical or thermal ablation, brachytherapy, or stent placement [9].

Recently, heat-based methods (laser, electrocautery, APC) have been used in combination with mechanical methods to maintain airway patency in interventional pulmonology. Such combinations have increased the success rates of clearing intraluminal obstructions, while minimizing hemorrhagic complications. Previous studies have agreed that mechanical resection combined with heat-based methods is the optimum approach to maintaining airway patency [8].

Among primary lung cancers, squamous cell carcinoma affects the major airways more often than adenocarcinoma, although both non-small cell carcinomas may lead to malignant airway obstructions [10]. In our study, the cases undergoing procedures due to malignant airway obstructions underwent argon plasma coagulation (APC), electrocautery and cryotherapy in addition to mechanical procedures.

In the study by Cosano et al., sharing their 5 years of experience, the authors detailed the interventional bronchoscopic therapy methods performed on 136 cases with central airway stenosis, which included laser therapy, balloon or mechanical dilatation, electrocauterization and stent applications [11]. Airway patency was provided with success rates of 92% and 96% in tumor-related and nontumor-related airway stenoses. The authors reported a mortality rate of 1.4%, with the most common complication being stent migration and granuloma formation. Interventional bronchoscopy is an effective method for the resolution of life-threatening obstructions of the central airways. Dyspnea improves immediately and there is no significant morbidity or mortality.

In this study, similar endoscopic therapies were used in the presence of airway obstructions in around half of the cases. We opted to use APC rather than a laser, and our rate of airway clearance was 92.3%, which is consistent with the literature. In the cases in our study, the number of stent applications was limited, and so there was a low rate of stent-related complications. There were no procedure-related deaths in the present study. As a major complication, two of the cases developed massive hemoptysis and were admitted to the intensive care after the procedure for follow-up and treatment.

Most carcinoid tumors emerge in the proximal airways and patients typically present with obstruction-related symptoms or hypervascularity-related bleeding [12]. There were obstruction-related post-obstructive pneumonia and dyspnea in three and hemoptysis in two of the five carcinoid cases in our study. Although surgical resection of the entire tumor is recommended for the treatment of carcinoid tumors, there have been studies supporting endobronchial therapy [13]. Distant organ metastasis, lymph node metastasis, and bronchial wall invasion are important when choosing the treatment for carcinoid tumors. In this study, cryotherapy was applied to the bronchial wall penetrated by the tumor after the tumor resection. The study by Brokx et al. reported that no surgical treatment was required in 42% of 112 cases with a centrally located pulmonary carcinoid who initially received bronchoscopic therapy after a minimum five-year follow-up [13]. Endobronchial therapy methods were applied to two cases in our study and no signs of recurrence were observed during a two-year follow-up. Two of our cases were treated surgically, and due to distant organ metastasis, one was administered systemic chemotherapy.

Tracheal tumors are rare but are mostly malignant. Squamous cell carcinomas and adenoid cystic carcinomas are the most common primary tracheal tumors [14]. In this study, in seven of the 10 cases undergoing procedures for tracheal tumors, the tumors were found to be malignant, while two patients were diagnosed with verrucous carcinoma, which caused airway obstruction as a result of tracheal invasion of the laryngeal tumor. Of the cases undergoing procedures for primary tracheal tumors, two were diagnosed with squamous cell carcinoma. Although rare in literature, one of our cases was diagnosed with adenocarcinoma. There were no signs of recurrence throughout the oncological treatment administered after the endotracheal therapy and in almost three years of follow-up. In one case, airway patency was maintained through endobronchial therapy methods as a result of tracheal invasion and the luminal extension of the thyroid papillary carcinoma.

Benign tracheal lesions include hemangiomas, hamartomas, neurogenic tumors, granular cell tumors and squamous papillomas [15]. In our study, one case was diagnosed with a hamartoma causing airway obliteration. Although hamartoma is the most common benign tumor of the lung, there are only a limited number of reports of endotracheally located hamartomas in the literature [16,17]. In line with the two cases presented by Hon et al., the lesion in the case in the present study was a pedunculated polypoid in the tracheal lumen [18]. Among the limited cases in the literature, surgical therapy was preferred for the case localized on the tracheal lumen with a wide base [17], while mechanical excision [18] or electrocautery combined with a mechanical method [16] was used in the thin-stalk polypoid cases, similar to the present study.

In the past, benign tumors were managed conventionally by surgical resection to maintain airway patency and to minimize symptoms. More recently, however, the development of endobronchial bronchoscopic methods has increased the use of laser, argon plasma coagulation, and cryotherapy for the management of benign tumors. The study of Dalar et al. identified endobronchial therapy to be as effective as invasive surgical methods in symptomatic benign tumors [19]. In the present study, endobronchial therapy was applied to benign lesions such as anthracosis, glandular papillomas, mucosal polyps, aortobronchial fistulas, endobronchial tuberculosis and hamartomas. APC, electrocautery, and cryotherapy were used in addition to mechanical methods during the procedures.

The conditions associated with non-malignant airway obstruction are defined in the literature as foreign body aspiration, tracheoabronchomalacia and tracheal stenosis due to endotracheal tube or anastomosis. In the present study, tracheal stenosis was detected in five cases, with three being post-intubation stenosis, one caused by tracheobronchopathia osteochondroplastica and the last being attributed to a post-intubation fungal infection in the granulation tissue.

Tracheobronchopathia osteochondroplastica is a rare disease that has been observed in 0.4% of bronchoscopies [20]. It is characterized by submucosal, bony, and cartilaginous nodules with a membranous tracheal wall preserved histologically. Despite the distinctive radiographical changes, severe airway obstruction is unusual [21]. Besides symptom-relieving treatment, no specific treatment is recommended. Laser ablation, surgical resection, and cryotherapy can be performed in cases complicated by severe airway stenosis or recurrent infection [22]. In the case in our study, dilatation was attempted due to severe airway stenosis, however airway patency could not be maintained and so a flat silicone stent was inserted into the stenotic area. For the two cases in the present study with post-intubation tracheal stenosis, a stenotic silicone stent was used following dilatation via a rigid bronchoscopy. Our two cases were operated on.

Foreign body aspiration is mostly seen in childhood, although it may also cause serious problems in adults. Risk factors for adults include trauma, drug or alcohol intoxication, or loss of consciousness due to anesthesia. In the present study, none of the risk factors were noted in cases identified with foreign body aspiration. Greater experience in bronchoscopy results in increased foreign body extraction via fiberoptic bronchoscopy, although rigid bronchoscopy is recommended for foreign bodies that cannot be extracted with a flexible bronchoscope [23]. The extracted foreign bodies were bone fragments and organic objects such as almonds and chickpeas.

Pulmonary alveolar proteinosis, known also as pulmonary alveolar phospholipoproteinosis is a rare disease of the lung that is characterized by the deposition of amorphous PAS (periodic acid-Schiff)-positive lipoprotein materials in distal air spaces [24]. Whole lung lavage is a therapeutic procedure used for the treatment of pulmonary alveolar proteinosis. In the present study, a total of 16 whole lung lavage procedures were performed on three cases diagnosed with PAP for therapeutic purposes. Consistent with the application methods noted in the literature, the whole lung lavage procedure was carried out through double lumen intubation under general anesthesia, followed using physiological saline solution at body temperature in two separate sessions, one week apart [25].

Conclusion

We believe that sharing the experience of bronchoscopists about developments in interventional bronchology procedures will contribute to the standardization of applications, and such treatments of more patients will improve achievements in this regard. Endobronchial therapies performed in interventional bronchoscopy are effective treatments for eligible patients and are highly effective in the presence of life-threatening central airway stenosis. Furthermore, such therapies are of great importance for patients who are illegible for surgery due to their clinical condition during the process of making them eligible for palliative and/or curative treatment. We believe that interventional procedures can be performed by bronchoscopists at experienced centers with low rates of mortality and morbidity.

Scientific Responsibility Statement
The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement
All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest
The authors declare no conflict of interest.

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